The role of HIT training in the general population and in cardiac patients

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Conflicts of Interest: None

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Outline

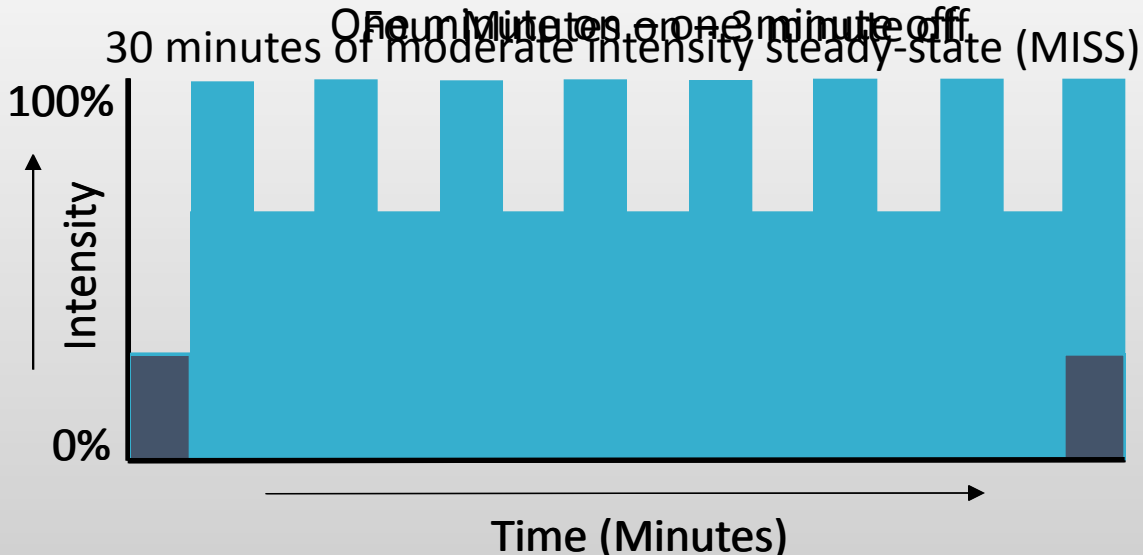
- Brief background of HIT
- The benefits of HIT – Focus on VO_{2peak}
- HIT in cardiac populations

What is HIT?

Repeat bouts of short duration high intensity exercise interspersed with short duration low intensity active recovery periods

Some disagreement in intensity zones - typically submaximal efforts >80% of maximal HR/>80 peak work rate

Variations in exercise volume/programme length



Where did HIT come from?

Reported as early as the 1920s in athletic populations

1954 - Sir Rodger Bannister used HIIT during as a medical student during his lunch break - achieved the 4 minute mile

1960's peer-reviewed literature begins to emerge in healthy/athletic populations

1970/80's– Evidence for interval and high intensity interval training in clinical populations begins to emerge

1996 – Katerina Meyer found that interval training in CHF resulted in – Assessed catecholamine, cardiac/metabolic stress, & dyspnoea - CHF patients tolerate HIIT.

Today – A vast volume of literature on the efficacy of HIIT in health and disease

Is it safe?

Table 1. The number of patients, exercise-hours and the corresponding number of cardiovascular events associated with moderate- and high-intensity exercise, respectively.

Center	Patients (n)	Total training (hours)	Moderate-intensity (hours)	High-intensity (hours)
Ålesund	775	25 720[1]	15 232	10 488[1]
Feiring	2629	85 208[2]	63 032[1]	22 176[1]
Røros	1442	64 892	51 192	13 700
Total	**4846**	**175 820**	**129 456**	**46 364**
Event rates:				
Cardiac arrest, fatal			1	0
Cardiac arrest, non-fatal			0	2
Myocardial infarction			0	0
Risk of events		**1/58 607**	**1/129 456**	**1/23 182**

The likelihood of a cardiac event in high risk individuals appears to be low when conducting either moderate, or high intensity exercise

Rognmo Ø *et al,* (2012)

Is it Effective?

VO_{2max}, insulin sensitivity and endothelial function all improve to a greater extent during HIIT, compared to MISS

Improved endothelial function/increased NO

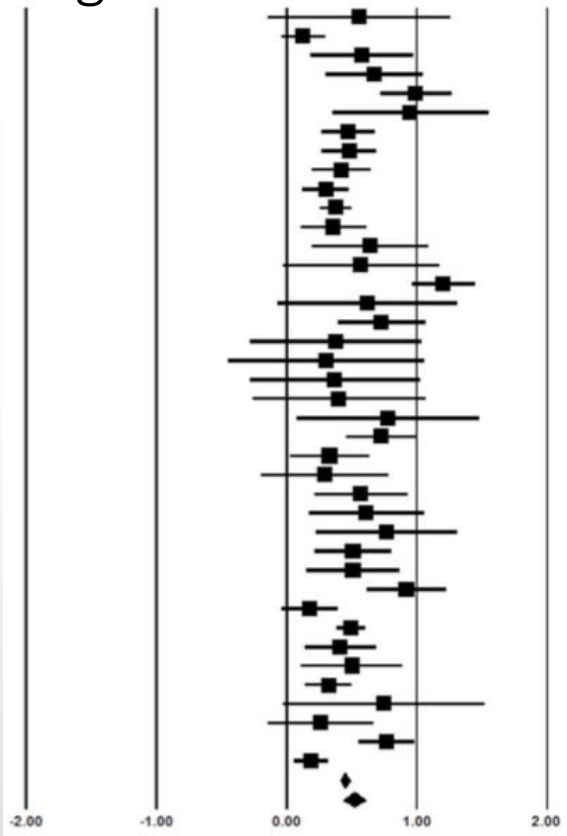
Greater depletion of muscle glycogen stores leading to enhanced muscle glycogen uptake →improve insulin sensitivity

Improvements in muscle oxidative capacity/mitochondrial volume/quality

Caveat: Findings can be variable

Is it Really Effective?

Higher Vol.



Bacon et al (2013)

Favours HIIT 0.51 L/min (43 to 0.60 L/min) up to 0.9 L for longer studies

Lower Vol.

	Effect on VO_{2max} (%)		Inference
	Mean	±90 % CL	
Effect on treatment groups[a]			
Sedentary males	10.0	±5.1	Possibly moderate ↑
Sedentary females	7.3	±4.8	Likely small ↑
Active non-athletic males	6.2	±3.1	Likely moderate ↑
Active non-athletic females	3.6	±4.3	Possibly moderate ↑
Athletic males	2.7	±4.6	Unclear
Controls	1.2	±2.0	Unclear

Weston et al (2014)

The effects of HIT appear to be greater in less fit populations

There is no definitive consensus on whether HIT is superior to *Well Prescribed* endurance exercise training apparently healthy/sedentary populations

Benefits of HIT in the General Population

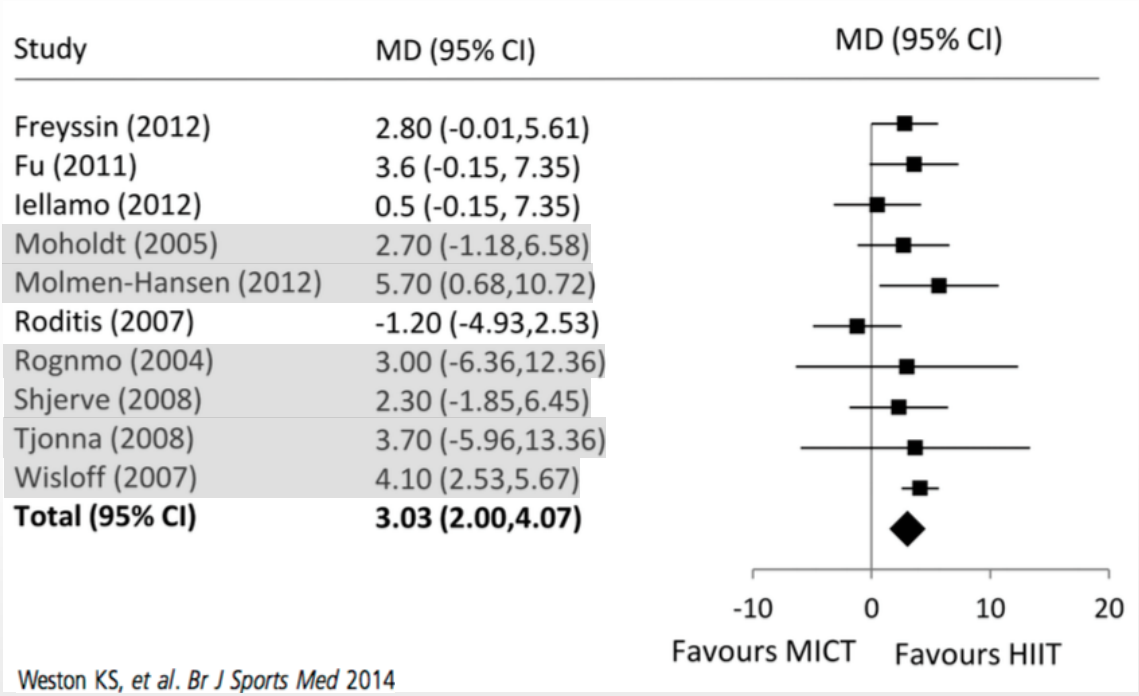
Type	Frequency	Time	Intensity	Result
MISS	Exercise 3 x p/week for 8 weeks	Exercise progressed from 20 to 35 minutes	~60% PPO	VO_{2peak} - MISS 9% : HIIT 15% a-VO_2 diff – MISS ↑: HITT ↑ Q_{max}: MISS ~ : HITT ↑ VO_2 Kinetics - MISS~ : HIIT: ↑ Exhaustion Time - MISS↑: MISS↑ ↑ Capillary/Fibre R - MISS↑: MISS↑
HIIT			4 min low / 1 minute 90% PPO	

Effect of interval versus continuous training on cardiorespiratory and mitochondrial functions: relationship to aerobic performance improvements in sedentary subjects

Frédéric N. Daussin,[1] Joffrey Zoll,[1] Stéphane P. Dufour,[1] Elodie Ponsot,[1] Evelyne Lonsdorfer-Wolf,[1] Stéphane Doutreleau,[1] Bertrand Mettauer,[1,2] François Piquard,[1] Bernard Geny,[1] and Ruddy Richard[1]

[1]CHRU of Strasbourg, Physiology and Functional Explorations Department, Civil Hospital, Strasbourg, France and University Louis Pasteur, Faculty of Medicine, Physiology Department, Strasbourg, France; and [2]Cardiology Department, Civil Hospital, Colmar, France

Is HIT Effective in Cardiac Populations?



Mean difference favours HIT by 3.03 mL/kg/min (95% CI 2.00 to 4.07; p<0.001)

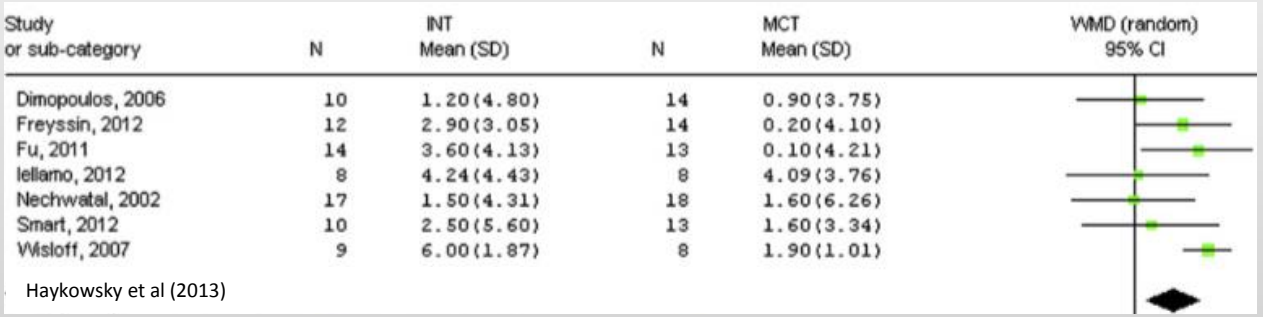
Six out of 10 studies conducted by the same research group

Only 273 patients included

Other systematic reviews/meta-analyses show similar results

Heart Failure Only

Mean difference favours HIT by 2.14 mL/kg/min (95% CI 0.66 to 3.63)



The Significance

VO_{2peak} is one of the strongest clinical prognosticators. Improvements in VO_{2peak} are consistently associated with improved survival:

- Kodama *et al.* (2009): ~103,000 patients; demonstrate 1 MET improvement in aerobic fitness confers 13% survival advantage
- Myers *et al.* (2002): ~6200 patients: 1 MET improvement in aerobic fitness confers 12% survival advantage
- Vanhees *et al.* (1995): 1% improvement in exercise training induced VO_{2peak} confers a 2% survival advantage in patients with CHD

@HIITorMISSUK

Pragmatic multi-centre RCT – 510 patients
Eight weeks – 2 x per week
10 x high intensity bouts at 85 - 90% PPO
10 x high intensity bouts at 20 - 25% PPO
Control group – standard care at 40-70% HRR
Assessed following intervention ~8 weeks and at 12 months
Primary outcome measure - VO_{2peak}
Also assessing other physiological, psychosocial and economic outcomes

BMJ Open

High-intensity interval training versus moderate-intensity steady-state training in UK cardiac rehabilitation programmes (HIIT or MISS UK): study protocol for a multicentre randomised controlled trial and economic evaluation

Gordon McGregor,[1,2] Simon Nichols,[3] Thomas Hamborg,[4] Lucy Bryning,[5] Rhiannon Tudor-Edwards,[5] David Markland,[6] Jenny Mercer,[2] Stefan Birkett,[3] Stuart Ennis,[1,2] Richard Powell,[1] Brian Begg,[2,7] Mark J Haykowsky,[8] Prithwish Banerjee,[1,9] Lee Ingle,[3] Rob Shave,[2] Karianne Backx[2]

@HIITorMISSUK

The Role of HIT in Cardiac Populations

Exercise-based cardiac rehabilitation for coronary heart disease (Review)

Heran BS, Chen JMH, Ebrahim S, Moxham T, Oldridge N, Rees K, Thompson DR, Taylor RS

THE COCHRANE COLLABORATION®

Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease

Cochrane Systematic Review and Meta-Analysis

Lindsey Anderson, PhD,* Neil Oldridge, PhD,† David R. Thompson, PhD,‡ Ann-Dorthe Zwisler, MD,§ Karen Rees, PhD,‖ Nicole Martin, MA,¶ Rod S. Taylor, PhD*

Changes in cardiorespiratory fitness in cardiac rehabilitation patients: A meta-analysis

Gavin Sandercock *, Valentina Hurtado, Fernando Cardoso

Rehabilitation after myocardial infarction trial (RAMIT): multi-centre randomised controlled trial of comprehensive cardiac rehabilitation in patients following acute myocardial infarction

Robert R West,[1] Dee A Jones,[2] Andrew H Henderson[3]

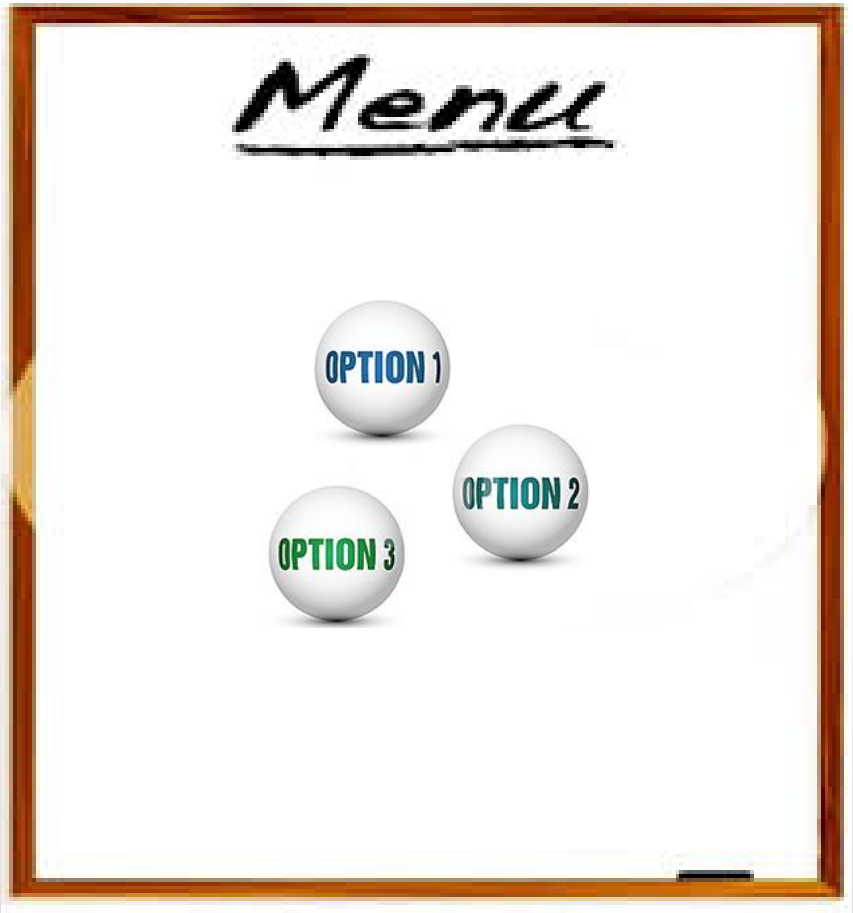
Cardiorespiratory fitness changes in patients receiving comprehensive outpatient cardiac rehabilitation in the UK: a multicentre study

Gavin R H Sandercock,[1] Fernando Cardoso,[1] Meshal Almodhy,[1] Garyfallia Pepera[2]

The minimum clinically important improvement in the incremental shuttle walk test following cardiac rehabilitation

Linzy Houchen-Wolloff, Sally Boyce and Sally Singh

The Role of HIT in Cardiac Populations



Summary

- Compared to MISS, HIT appears to provide superior health benefits
- Variation in HIT protocols and magnitude of benefit
- HIT appears to be safe and effective in cardiac populations – More ecologically valid research needed

Newcastle University

Thank You

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